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Coherence monitoring by good and poor comprehenders in elementary school: Comparing offline and online measures

This chapter is based on
Abstract

Central to children’s reading comprehension is their ability to construct a coherent mental representation of a text. This study examined whether children with good and poor comprehending abilities (N = 74; 8-9, 10-11 years) differ systematically in their coherence-monitoring skills, and if such differences are age-related. Within each age group, poor comprehenders had greater difficulty reporting a coherence break after reading compared to good comprehenders; in addition, older children outperformed younger children. Coherence-break detection during reading did not differ between good and poor comprehenders nor between age groups. In all age and ability groups, accuracy after reading was related to coherence-break detection during reading. These results suggest that poor comprehenders’ difficulties in coherence monitoring originate in encoding processes rather than in failure to detect coherence breaks during initial reading. Importantly, this was the case for children in both age groups.
2.1 Introduction

For children to succeed in school it is crucial that they are able to understand what they read. This requires that children master technical reading skills (learning to translate letter symbols into meaningful language) as well as comprehension skills (learning to construct meaning from a text). Despite the efforts of schools, approximately 25% of children do not reach the basic level of required comprehension skills at the end of elementary school (National Center for Education Statistics, 2011), even if many of these do possess sufficient technical reading skills (Cain & Oakhill, 2006; Catts, Adlof, & Weism, 2006; Hulme & Snowling, 2009). Lacking adequate comprehension skills severely limits their ability to understand and learn from texts. In order to design effective interventions for these children, it is necessary to understand the development of cognitive processes underlying reading comprehension and to determine how these processes differ between successful and struggling comprehenders (Hulme & Snowling, 2011). In the current study we investigated the ability of good and poor comprehenders in middle and upper elementary school on an essential component of reading comprehension, the ability to monitor the coherence of an unfolding text.

Reading comprehension is a complex ability combining many cognitive processes (e.g., Hannon, 2012) that undergo changes in development, especially in the elementary school years (Ehri et al., 2001; Oakhill & Cain, 2007; van den Broek, 1997). Various theoretical models of reading comprehension processes have been proposed (McNamara & Magliano, 2009). Most of these models share the notion that successful comprehension requires a reader to construct a coherent mental representation, or situation model, of a text (e.g., Graesser, Singer, & Trabasso, 1994; Kintsch, 1998; van den Broek, 1994). A situation model of a text goes beyond the literal text because readers add semantic relations between parts of the text and between the text and their background knowledge. To construct such a representation, readers need to monitor the coherence of the text and of their emerging mental representation during reading and to recognize—and correct—any disruptions to coherence. Detection of potential incoherence during reading contributes to successful comprehension because it enables a reader to adapt his or her reading behavior to restore coherence when needed. For example, readers can look back in the text, reread parts of the text, or apply their background knowledge (Duke & Pearson, 2002). Conversely, if a reader fails to notice coherence breaks their representation will be less coherent and, hence, comprehension suffers. Thus, the extent to which children are able to monitor coherence as they proceed through a text is a crucial factor in their success (and failure) in reading comprehension.

Prior research has shown that there are both developmental and individual differences in the ability to detect coherence breaks. With regard to developmental
differences, older children detect coherence breaks more often than younger children do (Markman, 1979; Oakhill & Cain, 2007; Vosniadou, Pearson, & Rogers, 1988)—a pattern that continues well into adolescence (Hacker, 1997). With regard to individual differences, poor comprehenders have greater difficulty detecting coherence breaks in texts and, as a consequence, construct less coherent mental representations of a text than good comprehenders do (Cain & Oakhill, 2007; Garner, 1981; Oakhill, Hartt, & Samols, 2005).

Most studies on coherence break detection by children have used measures of semantic contradiction detection after reading was completed, that is, offline. For example, in one study 10-12-year-old children were asked to judge whether stories they just read made sense or not (Garner, 1981). In another study, 6-11-year-old children were asked to recall stories and indicate what it was about the story that did not make sense and to justify their responses (Vosniadou et al., 1988). In a study with older participants, 12-17-year-old children were asked to read texts and then underline parts of the text that did not fit (Hacker, 1997). To gain insight into the causes of such developmental differences and of difficulties that poor comprehenders at different ages experience, it is crucial to consider the execution of cognitive processes during reading, that is, online. Consideration of the processes during reading is not only important for theoretical models of reading comprehension and coherence monitoring but also for educational practice, to allow for the development of effective interventions. For example, if poor comprehenders’ difficulty concerns the initial perception of a coherence break then optimal remediation would be different than if their difficulty concerns later stages of processing, where the reader adapts his or her reading behavior.

A powerful method that is used to investigate coherence monitoring during reading by adults involves measuring reading times in a self-paced contradiction paradigm (Albrecht & O’Brien, 1993; O’Brien & Albrecht, 1992; O’Brien, Rizzella, Albrecht, & Halleran, 1998). In this paradigm participants read narratives sentence-by-sentence on a computer screen in a self-paced manner. Readers are instructed to read for comprehension and answer questions that will follow; thus, they are not explicitly asked about possible contradictions. Reading times for each sentence are recorded. Some of the narratives contain a semantic contradiction between information presented early in the text and information presented in a target sentence later in the text. For example, in one text Mary is introduced as a vegetarian but later in the text she orders a cheeseburger (Albrecht & O’Brien, 1993). When reading times for target sentences from consistent narratives are compared to those from inconsistent narratives, proficient adult readers usually show a so-called inconsistency effect: processing inconsistent target sentences takes more time compared to processing consistent target sentences. The difference reflects online coherence break detection (Gerrig & O’Brien, 2005; O’Brien, Cook, & Gueraud, 2010).
The contradiction paradigm has been used successfully to study online coherence break detection, including differences between good and poor comprehenders. For example, good and poor comprehenders showed an inconsistency effect when two pieces of inconsistent information were presented in adjacent sentences, but only good comprehenders continued to show an inconsistency effect when conflicting pieces of information were separated by intervening sentences. This has been observed for adults (Long & Chong, 2001) and for 10-12-year-old children (van der Schoot, Reijntjes, & van Lieshout, 2012).

By combining offline methods with online methods such as the contradiction paradigm, it is possible to gain insight into the points in processing where coherence-monitoring problems are most likely to originate. Incoming textual information is processed in several stages before it is incorporated in the reader’s situation model or mental representation of the text as a whole (Cook & O’Brien, 2014; Isberner & Richter, 2014a; Singer, 2013; van den Broek, Young, Tzeng, & Linderholm, 1999). With regard to coherence monitoring, an important distinction is between the initial detection of a potential coherence break and subsequent encoding of such a coherence break into the reader’s memory representation of the text. Detection of a coherence break during initial reading of a new text element results from a rapid validation of incoming information against prior text and/or background knowledge (Cook & O’Brien, 2014; Isberner & Richter, 2014b; Singer, 2013). Successful detection depends on the degree to which relevant information from earlier text and background knowledge is readily available in the reader’s working memory at the time the new information is being processed and the efficiency of the matching process (Singer & Doering, 2014). Encoding of a coherence break, once detected, depends on factors such as the reader’s standards of coherence, his or her comprehension strategies, and the efficiency of memory storage processes (e.g., Pressley & McCormick, 1995; van den Broek, Bohn-Gettler, Kendeou, Carlson, & White, 2011).

The aim of the current study is to investigate good and poor comprehenders’ ability to detect and encode coherence breaks in materials they read, and to determine if possible problems tend to originate during the initial detection or in the subsequent processing and encoding of a detected coherence break. We consider these questions for two age groups, 8-9-year-old and 10-11-year-old children, to determine if the source of coherence-monitoring problems may differ for different age groups. For the younger age group, reading development and instruction typically are centered around basic reading skills such as decoding, syntax, and vocabulary, with relatively little emphasis on comprehension of texts. For the older group, development and instruction center mostly around understanding of texts as a whole and on extracting knowledge from the texts (Best, Floyd, & McNamara, 2008). Thus, the selected age groups represent both
ides of the transition from ‘learning to read’ to ‘reading to learn’ (Chall, 1996) although children engage in coherence building processes well before formal education starts (e.g., Bauer, 2002; Kendeou, White, van den Broek, & Lynch, 2009). In addition, because of the need to attend to basic processes the younger group may have relatively fewer cognitive resources available for comprehension processes such as coherence monitoring, whereas for the older group basic skills may be more automatized, leaving more cognitive resources available for coherence monitoring (Kendeou, Papadopoulos, & Spanoudis, 2012; Perfetti, 1985, 2007).

The logic of the current study is similar to that used by Zabrucky and Ratner (Zabrucky & Ratner, 1986, 1989, 1992) in a series of studies on elementary school children’s ability to monitor whether they understand what they read. Following Baker (1985), these authors distinguished between comprehension-monitoring components related to the initial perception of coherence breaks (evaluation) and those related to the possible adaptation of reading behavior to restore comprehension (regulation). Elementary school children read short narratives that contained information that was either consistent or inconsistent with prior information from the text. A comparison of coherence monitoring by 8-9 and 11-12-year-old children, respectively, showed that after reading was completed (i.e., offline) the older children were more likely to report coherence breaks than were the younger children but that during reading (i.e., online) the younger and older children both detected coherence breaks (Zabrucky & Ratner, 1986). In subsequent studies, good and poor 11-12-year-old readers were compared. Results showed that offline, good readers were more likely to report coherence breaks than were poor readers but that both good and poor readers detected coherence breaks online (Zabrucky & Ratner, 1989, 1992). These findings suggest that differences in coherence-monitoring ability between these age groups and between good and poor readers in the older age group, do not originate in difficulties detecting coherence breaks during reading.

The current study extends the above research by investigating (a) whether children with good and children with poor reading-comprehension ability differ systematically in their coherence-monitoring skills at the detection and encoding stages and (b) if any such differences depend on age (8-9-years vs. 10-11-years-old). In addition, we consider the direct relation between online coherence break detection and subsequent encoding. Insight into this relation and whether it differs for children in different age and ability groups is important for our understanding of the development of reading comprehension skills. Finally, whereas the earlier studies used a small number of items the current study used 16 narratives per condition.

We adapted the contradiction paradigm by creating narratives that were age-appropriate, in terms of length and required background knowledge, and by including
consistency judgments following each narrative. These adaptations enabled us to examine good and poor comprehenders’ ability to detect coherence breaks both online (reading times) and offline (consistency judgments). We defined poor comprehenders as those children that scored below average on standardized measures of reading comprehension despite having sufficient basic reading skills.

With regard to offline results, the earlier findings reviewed above lead to the expectation that the ability to correctly judge the consistency of short narratives after reading is better in good comprehenders compared to poor comprehenders and that this ability increases with age. With regard to online results, we hypothesized that if offline differences between good and poor comprehenders originate in difficulties to detect inconsistencies online (Long & Chong, 2001; van der Schoot et al., 2012), then the reading time data would show typical inconsistency effects for the good comprehenders, but not for poor comprehenders. If, in contrast, offline differences between good and poor comprehenders do not originate in insufficient online detection processes (Zabrucky & Ratner, 1986; 1989; 1992), then the reading time data would show typical inconsistency effects for good as well as poor comprehenders in both age groups.

2.2 Method

2.2.1 Participants
Seventy-four native Dutch-speaking elementary-school children participated in this study. Children were in grades 3 (8-9-year-old children, \( N = 35, M_{\text{age}} = 8.90, SD = .31 \)) and 5 (10-11-year-old children, \( N = 39, M_{\text{age}} = 10.99, SD = .05 \)). Participants were recruited through six different schools in the Netherlands. Children with a diagnosis of dyslexia or developmental disorders such as ADHD or Autism-Spectrum Disorders were excluded.

Selection of good and poor comprehenders
For children whose parents gave informed consent, standardized scores on a word decoding test (Drie Minuten Test (DMT); Verhoeven, 1995) and reading comprehension test (Toets Begrijpend Lezen; Staphorsius & Krom, 1998) were obtained from their school records. The DMT is a word decoding test on which children have to read aloud words without context as fast and as accurately as they can. The reading comprehension test is a paper-and-pencil test in which children have to answer a mix of text-based and inferential questions. The test consists of age-normed texts in various text genres (e.g., narrative and expository texts) and two types of multiple choice questions: questions on the content of a text and questions where respondents have to fill out blanks in a text. These tests are developed by CITO (Centraal Instituut voor Toetsontwikkeling), the Dutch national institute for measurement in education, which also provides national
norms for these tests for each grade. Based on the word decoding test (DMT) children with average or above average word decoding ability were identified. From this group, children that scored in the lowest or the highest 40% of the CITO norm scores on the reading comprehension test were included in the final sample. Participants that scored in the highest 40% of the norm scores were considered good comprehenders, those that scored in the lowest 40% were considered poor comprehenders. Means and standard deviations of CITO scores on the reading comprehension test as well as other participant information for all groups are displayed in Table 2.1. Data for three additional participants (two poor comprehending 8-9-year-old children and one poor comprehending 10-11-year-old child) were removed from the analyses because they performed at or below chance level in the experimental task.

**Table 2.1** Participant Information as a Function of Age and Comprehension Skill.

<table>
<thead>
<tr>
<th></th>
<th>8-9-year-old children</th>
<th>10-11-year-old children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good comprehenders</td>
<td>Poor comprehenders</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>31 %</td>
<td>67 %</td>
</tr>
<tr>
<td><strong>Age (M and SD)</strong></td>
<td>8.94 (.34)</td>
<td>8.81 (.27)</td>
</tr>
</tbody>
</table>
| **CITO Reading compre-
|                     | 37.22 (8.02)          | 14.50 (3.66)            | 57.35 (9.64)        | 31.63 (8.13)         |

### 2.2.2 Materials

**Contradiction paradigm**

Participants read 32 narratives that were appropriate in terms of content and structure for primary school children and were adapted from materials used by O’Brien and colleagues (O’Brien & Albrecht, 1992; O’Brien et al., 1998). All narratives were at a reading ability level of texts that are typically used in grade 3 through 5, based on the readability index used in the Netherlands (CLIB; Evers, 2008). Each narrative consisted of six sentences. Narratives were presented one sentence at a time on a computer screen. Each narrative consisted of an introductory first sentence, a second sentence that described a characteristic of the protagonist or the situation, three filler sentences, and a final (target) sentence. All sentences consisted of approximately 10 words ($M = 10.18$, $SD = 1.84$) or 15 syllables ($M = 14.52$, $SD = 2.72$). We created a consistent (without a coherence break) and an inconsistent (with a coherence break) version of each narrative by manipulating the content of the second sentence: it presented information that was
Coherence monitoring by good and poor comprehenders in elementary school

semantically either consistent or inconsistent with information presented in the target sentence. The length of the target sentences varied between 8 and 14 words ($M = 10.56$, $SD = 1.97$) or 10 and 20 syllables ($M = 15.19$, $SD = 2.73$). For an example narrative see the Appendix.

Participants read one version of each narrative sentence-by-sentence by pressing the spacebar on a laptop to advance to the next sentence. Reading times were recorded for each sentence. To discourage participants from pressing the button too rapidly, a fixation cross was presented for 500 ms between sentences and participants were unable to advance to the next sentence during the first 500 ms that each sentence was shown. If participants did not respond within 10 seconds, the next sentence automatically appeared. To reduce routinized bar pressing, the final sentence was preceded by a fixation of variable duration (between 500 and 3000 ms). Reading times for the target sentences in inconsistent and consistent narratives were used as a within-subjects measure of online coherence monitoring: Longer reading times for inconsistent target sentences compared to consistent target sentences would reflect coherence break detection during reading.

Following each narrative participants made a consistency judgment (“Did this story make sense?”) and answered a comprehension question about the content of the narrative with a ‘yes’ or ‘no’ button press (using the ‘S’ and ‘L’ keys, respectively). The words ‘yes’ and ‘no’ were presented at the left and right lower corner of the screen, respectively. A fixation point of three asterisks was presented for 2000 ms between narratives. Percentage correct responses to the consistency questions was used as an offline measure of coherence monitoring. The comprehension questions were included to ensure that the participants followed the instruction to read for comprehension.

The 32 narratives were presented to participants in one of two orders. Within each order, there were two versions in which half of the narratives were presented in their consistent version and the other half in their inconsistent version. This resulted in four lists in which there was a maximum of three subsequent consistent or inconsistent narratives. Across participants within each age/skill group every narrative occurred equally often in each version.

2.2.3 Procedure

The task was administered individually by the experimenters in a quiet room at the children’s school. Each participant was instructed to read a number of narratives for comprehension at a normal pace (as they would normally read stories, not faster or slower) and to answer two questions about each narrative on a laptop.

Participants received four practice narratives, two contained a coherence break. Each practice narrative was followed by the consistency question and comprehension
question (see Appendix). If a child did not report the inconsistency, it was pointed out by the experimenter. Two practice narratives were read on paper. The other two practice narratives were presented sentence-by-sentence on the computer, to allow children to get used to the procedure of the task. During the practice trials participants were able to look back in the text. Narratives were presented in white letters against a black background on a 14.1 inch screen. Care was taken that each participant understood the task after practice.

Before starting the experiment, the instruction to read at a normal pace was repeated. In addition, participants were told that it would not be possible to look back in the text, and that they had to keep their fingers on the keys. The 32 narratives were presented in three blocks, with short breaks after 12 and 22 narratives, respectively. During one of these short breaks participants were offered a drink and a small snack. For each participant, the task took approximately 30 minutes to complete after which participants were thanked for their participation and given a small reward.

2.3 Results

2.3.1 Offline coherence-break detection

Participants’ offline coherence-monitoring ability was examined by computing the percentage correct responses to the consistency question that followed each narrative. These accuracy scores were submitted to a repeated measures ANOVA with comprehension skill (good vs. poor) and age group (8-9 vs. 10-11 year) as between-subjects factors and narrative consistency (consistent vs. inconsistent) as within-subjects factor. Mean percentages correct responses by good and poor comprehenders within each of the two age groups are presented in Table 2.2.

<table>
<thead>
<tr>
<th>Narrative Condition</th>
<th>8-9-year-old children</th>
<th>10-11-year-old children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good comprehenders</td>
<td>Poor comprehenders</td>
</tr>
<tr>
<td>Consistent</td>
<td>86.96 (8.82)</td>
<td>82.81 (12.82)</td>
</tr>
<tr>
<td>Inconsistent</td>
<td>83.97 (8.39)</td>
<td>72.40 (11.14)</td>
</tr>
</tbody>
</table>

As hypothesized, there was a significant main effect of comprehension skill, $F(1, 70) = 21.73, p < .001, \eta^2_p = .237$, with good comprehenders ($M = 87.18\%$, $SE = 1.03$) responding more accurately to consistency questions than poor comprehenders ($M = 79.67\%$, $SE = 1.24$), and a significant main effect of age group, $F(1, 70) = 5.54, p = .021, \eta^2_p$.
Coherence monitoring by good and poor comprehenders in elementary school

=.073, with 10-11-year-old children (M = 85.33 %, SE = 1.08) responding more accurately to consistency questions than 8-9-year-old children (M = 81.53 %, SE = 1.20). There was no significant interaction between comprehension skill and age group, F(1, 70) = .05, p = .830. In addition, there was a significant main effect of narrative consistency, F(1, 70) = 5.81, p = .019, ηp² = .077, with participants judging consistent narratives accurately (i.e., as consistent) (M = 85.37 %, SE = 1.30) more often than inconsistent narratives (i.e., as inconsistent) (M = 81.18 %, SE = 1.19). None of the within-subjects interactions were significant (all p's > .189).

2.3.2 Online coherence-break detection

Participants’ target sentence reading times were submitted to a repeated measures ANOVA with comprehension skill (good vs. poor) and age group (8-9 vs. 10-11 year) as between-subjects factors and narrative consistency (consistent vs. inconsistent) as within-subjects factor. There was a significant main effect of narrative consistency, F(1, 70) = 8.29, p = .005, ηp² = .106, with longer reading times for target sentences in inconsistent narratives (M = 252.49 ms, SE = 5.98 ms) than for target sentences in consistent narratives (M = 241.59, SE = 5.91 ms). There was no significant main effect of comprehension skill, F(1, 70) = .04, p = .834, but there was a significant main effect of age group, F(1, 70) = 8.87, p = .004, ηp² = .112, with 10-11-year-old children reading target sentences faster (M = 230.26 ms, SE = 7.54 ms) than did 8-9-year-old children (M = 263.82 ms, SE = 8.34 ms). Importantly, there were no significant interactions of narrative consistency with comprehension skill and/or age group (all p's > .35), indicating that the inconsistency effect occurred for all age and comprehension ability groups. Finally, there was no significant interaction between comprehension skill and age group, F(1, 70) = 2.68, p = .106.

2.3.3 Relation between offline and online measures of coherence break-detection

To examine how offline consistency judgments are related to online reading times we conducted separate analyses for online target-sentence reading times for those trials on which participants had made a correct (84.21 % of all trials) and incorrect (15.79 % of all trials) consistency judgment, respectively.

If the processes revealed by reading times are important for subsequent encoding the typical inconsistency effect should precede correct offline judgments. With respect to incorrect offline judgments, two scenarios are possible. One possibility is that the incorrect judgments could be caused by a failure to detect the inconsistencies during reading; in this scenario target-sentence reading times preceding incorrect offline consistency judgments would not show the
typical inconsistency effect. Alternatively, incorrect judgments could be caused by a failure in post-detection processing; in this scenario target-sentence reading times preceding incorrect offline judgments would show an inconsistency effect.

**Reading times preceding correct offline consistency judgments**

Results on the target-sentence reading times on trials preceding a correct consistency judgment show a significant main effect of narrative consistency, $F(1, 70) = 7.75, p = .007$, $\eta_p^2 = .10$, with longer reading times for target sentences in inconsistent narratives ($M = 253.12$ ms, $SE = 6.08$ ms) than in consistent narratives ($M = 240.53$ ms, $SE = 6.13$ ms). There was no significant main effect of comprehension skill, $F(1, 70) = .05, p = .827$, but there was a significant main effect of age group, $F(1, 70) = 8.74, p = .004$, $\eta_p^2 = .11$, with 10-11-year-old children reading faster ($M = 230.07$ ms, $SE = 7.58$ ms) than 8-9-year-old children ($M = 263.57$ ms, $SE = 8.42$ ms). There were no significant interactions of narrative consistency with comprehension skill and/or age group (all $p$’s > .36), indicating that the inconsistency effect was similar across age and comprehension ability groups. Finally, there was no significant interaction between comprehension skill and age, $F(1, 70) = 3.17, p = .079$.

**Reading times preceding incorrect offline consistency judgments**

Results on the target-sentence reading times on trials preceding an incorrect consistency judgment show no significant main effect of narrative consistency $F(1, 50) = .09, p = .766$. Reading times for target sentences in inconsistent narratives ($M = 247.54$, $SE = 10.03$) were not significantly longer than target sentences in consistent narratives ($M = 244.11$ ms, $SE = 10.35$ ms). No other main effects or interactions were significant (all $p$’s > .16).

**2.4 Discussion**

The aims of this study were to investigate coherence-monitoring skills in 8-9 and 10-11-year-old children and to determine, for each age group, whether potential difficulties that children with poor comprehension skills experience originate in detecting or in subsequent encoding of coherence breaks. The offline results show that the ability to correctly judge the consistency of narratives after reading improves with age: 10-11-year-old children outperformed 8-9-year-old children. Furthermore, within each age group children with poor comprehension skills were less able to correctly judge the consistency of the narratives than were children with good comprehension skills. These results are in line with previous findings that offline coherence break detection differs as a function of comprehension ability (Cain & Oakhill, 2007; Garner, 1981; Zabrucky & Ratner, 1989; Zabrucky & Ratner, 1992) and improves with age.
Coherence monitoring by good and poor comprehenders in elementary school

(Hacker, 1997; Markman, 1979; Vosniadou et al., 1988). They also extend earlier findings by showing that the difference between good and poor comprehenders also holds in the youngest age group.

To determine if the observed differences in the awareness of coherence breaks in narratives originate during the initial detection of a coherence break or in the subsequent processing and encoding, we compared reading times for consistent and inconsistent target sentences. Results indicate that both good and poor comprehenders show the typical inconsistency effect of slowing down when reading inconsistent information, in both the 8-9 and the 10-11-year age groups. These results suggest that the observed individual and developmental differences in offline reporting of coherence breaks are not caused by difficulties in detecting breaks in coherence during initial reading—in each age group poor comprehenders slowed down at inconsistent target sentence just as good comprehenders did. A similar pattern was found when a very different type of inconsistency—in syntax and spelling—was investigated in 9-10-year-old children (Oakhill et al., 2005). Good and poor comprehenders hesitated equally often at the initial reading of the inconsistencies but good comprehenders afterwards more often reported having read an inconsistency than did the poor comprehenders. Thus, detection of these types of inconsistencies also seems to be similar for good and poor comprehenders, but subsequent processing differentiates the two groups.

Our findings indicate that difficulties that younger and, within each age group, poor comprehenders experience in reporting coherence breaks from the texts they read originate in the processing after the phase of initial coherence break detection. This possibility is consistent with recent theoretical and experimental investigations of possible stages in the processing of incoming information, for example concerning validation processes to construct coherence during reading (Cook & O’Brien, 2014; Isberner & Richter, 2014a; Singer, 2013; van den Broek et al., 2011). Processes after initial detection of coherence breaks may take various forms. For instance, Zabrucky and Ratner (1989) observed that, among 11-12-year-old children, good comprehenders looked back to prior text more often following coherence breaks than did poor comprehenders. Likewise, there is considerable evidence of individual and developmental differences in inferential processing in an attempt to create coherence (Bowyer-Crane & Snowling, 2005; Casteel, 1993; Kendeou, Bohn-Gettler, White, & van den Broek, 2008; Oakhill & Cain, 2012; van den Broek, 1997). It also is conceivable that automatic coherence-building processes following detection of a coherence break are more effective in good than in poor comprehenders. Investigation of differences in the processing of coherence breaks between good and poor—and older and younger—readers would deepen our understanding of developmental and individual differences in comprehension skill and support the development of interventions targeted specifically at the processes that
distinguish good and poor comprehenders. The current results suggest that coherence-restoring processes after the initial detection of coherence breaks may be particularly good candidates for such intervention.

In addition to shedding light on group differences in online and offline sensitivity to coherence breaks, the current results allow examination of the direct relation between online detection and offline representation of coherence breaks. Correct offline consistency judgments were preceded by an online inconsistency effect, whereas incorrect consistency judgments were not. This pattern was observed for both age groups and, within each age group, for both good and poor comprehenders. Thus, regardless of age and comprehension skill, online processes did have a consequence for offline representation of the texts as consistent or inconsistent. This conclusion should be viewed as suggestive only because the number of items that triggered incorrect responses was limited. Together, the findings in this study indicate that detection of inconsistencies is necessary but not sufficient for encoding inconsistencies in offline text representations.

Although our results and those of others (e.g., Zabrucky & Ratner, 1989; 1992) suggest that problems in coherence monitoring do not originate in the initial detection of coherence breaks, it is possible that younger or poorly comprehending children would experience difficulty with detection as well if the materials would be more challenging. For instance, detection of coherence breaks may become more difficult when the textual distance between the contradicting information increases. This prediction is consistent with observations that poor comprehenders may show less evidence of online coherence break detection when longer texts are used (e.g., Long & Chong, 2001; Oakhill et al., 2005; van der Schoot et al., 2012).

To conclude, this study extends the present literature on the development of reading comprehension by capturing online and offline aspects of coherence-monitoring ability in good and poor comprehenders in two age groups in elementary school. In addition, this study attempted to bridge a gap in the current knowledge by providing insights in the relation between these online and offline aspects of coherence monitoring. The results of the present study contribute to our understanding of individual differences in reading comprehension ability in middle childhood, and highlight the importance of further insights into the cognitive processes that readers engage in during reading.
Appendix

Example of Narrative Presented Sentence-by-Sentence in the Computerized Reading Task in a Consistent and Inconsistent Version (adapted from Albrecht & O’Brien, 1993).

Introduction
Oscar and Ruben are ten-year-old twins who do almost everything together.

Consistent version
Because there has been a lot of snow in the past few days, they don’t have to go to school today.

Inconsistent version
Because the weather has been very hot in the past few days, they don’t have to go to school today.

Filler sentences
Their mother works for a large company and is working from home today. Today she is very busy with her work, she has to finish a report. Oscar and Ruben are playing outside so they do not disturb her.

Target sentence
They are building a snowman in the backyard.

Consistency Question
Did this story make sense? Yes / No

Comprehension Question
Are Oscar and Ruben of the same age? Yes / No